

Community Earth System Model

A Framework for Collaborative Research

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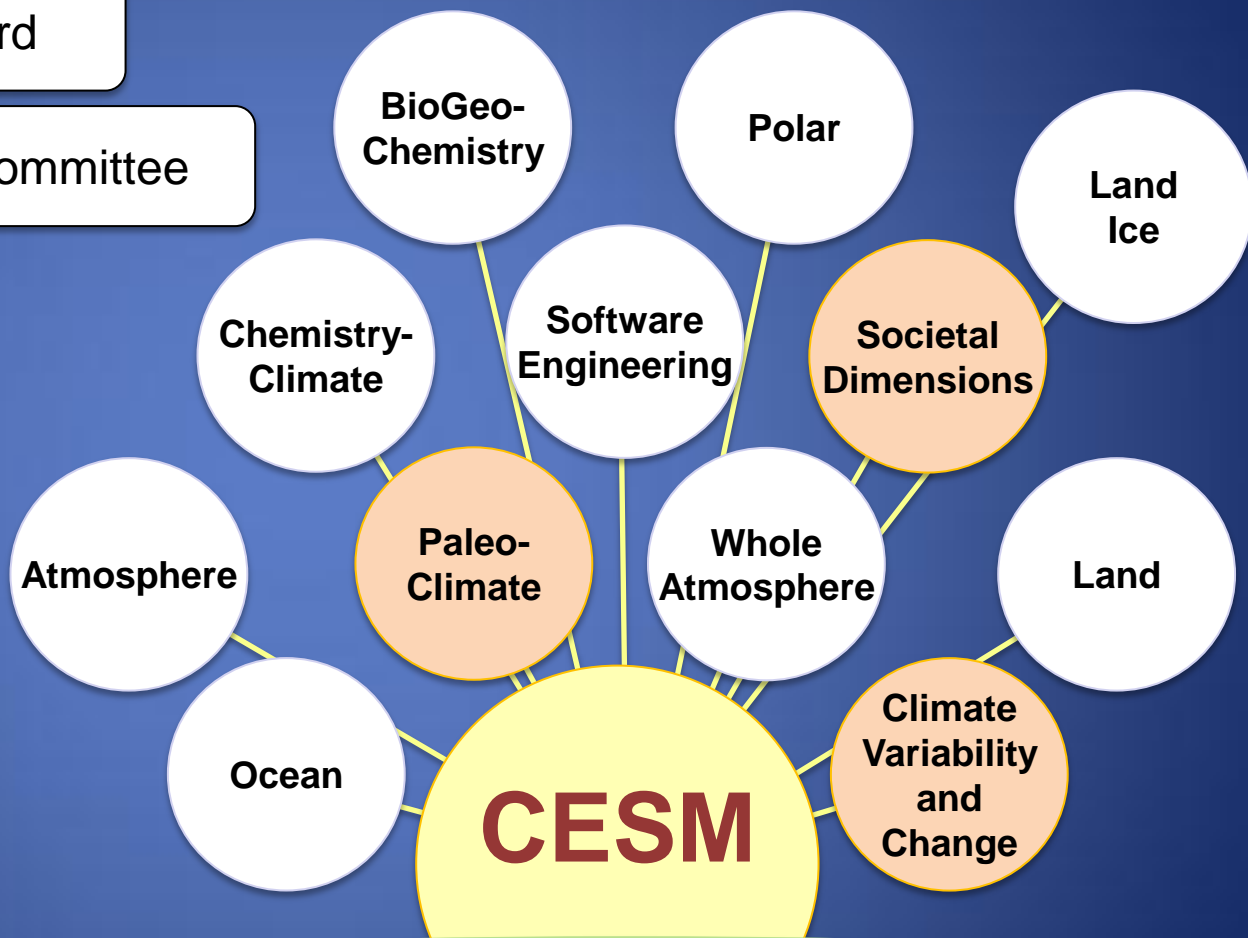


CESM Management Structure

12 working groups – encompassing both model development and applications

CESM Advisory Board

CESM Scientific Steering Committee



CESM is primarily sponsored by the National Science Foundation and the Department of Energy

<http://www.cesm.ucar.edu/management>

CESM Project Experiments

Information from <http://www.cesm.ucar.edu/experiments/cesm1.0/index.html>

Community Earth System Model

CESM 1.0 EXPERIMENTS, DATA AND DIAGNOSTICS

Stand-Alone Diagnostics

- CAM4.0
- CAM5.0
- CLM4.0
- CICE4.0
- POP2

J. Climate Special Issue Collection

- CCSM4
- CESM1 (restricted)

Note that although CESM1.0 supersedes CCSM4.0, users can run equivalent CCSM4.0 experiments from the CESM1.0 code base. Also note that the CCSM4.0 experiments below are equivalent to running CESM1.0 (CAM4). All current CESM release codebases (e.g. cesm1_0, cesm1_0_1, etc.) can also reproduce the climates shown below.

If you still have questions after reviewing the details of the model runs below, it is recommended that you contact the relevant [CESM Working Group Liaison](#).

Note about CCR diagnostics: Sudden large spikes in CCR diagnostic fields most likely indicate a CCR software diagnostics failure, and have absolutely nothing to do with the fidelity of the simulation. Use CCR diagnostics with caution.

[Jump To:](#) [Control Simulations](#) [20th Century Single-Forcings Simulations](#) [20th Century All-Forcings Simulations](#) [RCP Simulations](#) [AMIP Simulations](#) [CO₂ Simulations](#) [Paleoclimate Simulations](#)

CONTROL SIMULATIONS

Brief Description	Case Details	Diagnostics				Length of Run Diagnostics		
CCSM4 1* Pre-Industrial Control Case Name: b40.1850.track1.1deg.006 Data Location: ESG	Details	863-892 w/observations	Atm	Ice	Land	Ocean	CCR	Ocean Timeseries
		863-882 - CCSM3 T85 Pre-Industrial Control	Atm	Ice	Land	Ocean		
CCSM4 1* Pre-Industrial Control (MOAR) Case Name: b40.1850.track1.1deg.006a Data Location: ESG	Details	1050-1079 w/observations	Atm	Ice	Land	Ocean	---	Ocean Timeseries
CCSM4 2* Pre-Industrial Control Case Name: b40.1850.track1.2deg.003 Data Location: ESG	Details	501-530 w/observations	Atm	Ice	Land	Ocean	CCR	Ocean Timeseries
		501-520 - CCSM3 T42 Pre-Industrial Control	Atm	Ice	Land	Ocean		

PI Controls

- CCSM4: 1°, 2°, T31,
- CESM1: BGC, FASTCHEM, WACCM

20C runs

- All forcings-6 members
- single forcings

RCPs 2.6, 4.5, 6.0, 8.5

- 6 ensemble members

Paleoclimate Runs:

- Last Millenium, LGM, Mid-Holocene

Additional CESM1.0(CAM5) runs including 1° and 2° 1850, 20C and RCPs

CCSM4/CESM1 J. Climate Special Collections

- 31 Papers available via AMS early-online release
- Numerous other papers in various stages of review
- Many CESM papers still in preparation
- Document major model components and aspects of simulated variability and change



The screenshot shows the AMS Journals Online website. At the top, there are logos for the American Meteorological Society and AMS Journals Online. Navigation links include Journals, Subscribe, For Authors, Information, and Online Help. A search bar is present with a 'Quick Search' button and a 'Full Text' dropdown menu. Below the navigation bar, the URL [All Publications > CCSM4/CESM1](#) is displayed. The main content area is divided into two sections: 'CCSM4 Special Collection' and 'CESM1 Special Collection'. Each section has a 'Theme Description' and a list of papers. The CCSM4 section describes a collection of papers analyzing results from the recently completed and released Community Climate System Model, version 4. The CESM1 section describes a collection of papers analyzing results from the recently completed and released Community Earth System Model, version 1. Below these sections, there is a list of organizers and a list of papers with abstracts and PDF links. The papers listed include: 'Tropical Atlantic Biases in CCSM4', 'Climate system response to external forcings and climate change projections in CCSM4', 'Climate Sensitivity of the Community Climate System Model Version 4', 'Contrasts between urban and rural climate in CCSM4 CMIP5 climate change scenarios', and 'Late 20th century simulation of Arctic sea ice and ocean properties in the CCSM4'.

CCSM4 Special Collection

Theme Description:

This collection consists of papers analyzing results from the recently completed and released Community Climate System Model, version 4; see <http://www.cesm.ucar.edu/models/cesm4/>. The coupled simulations range from runs of past paleoclimates, a long preindustrial control forced by 1850 conditions, an ensemble of 20th century runs, and four ensembles of the future climate using different Representative Concentration Pathways.

CESM1 Special Collection

Theme Description:

The second part of this collection has papers analyzing results from the recently completed and released Community Earth System Model, version 1; see <http://www.cesm.ucar.edu/models/cesm1/>. The new components that are available which turn it into an Earth System Model are: carbon cycle modules in the land, ocean, and atmosphere components; an interactive chemistry component in the atmosphere; a version of the atmosphere that reaches into the upper stratosphere, called WACCM; and a completely new land ice component. In addition, an updated version of the atmosphere component, CAM5, is available, which uses several new parameterizations, and can simulate the indirect effects of aerosols.

The CCSM4/CESM1 Special Collection organizers are:

Peter Gent, Past Chairman of the CCSM Project SSC (gent@ucar.edu)
Jim Harrell, Chairman of the CCSM Project SSC (jharrell@ucar.edu)

Abstracts for all AMS articles are available to everyone, as is the full text of Bulletin articles. Access to full-text HTML and PDF articles in the technical journals is limited to paid subscribers.

 denotes open access content.

Seriyon A. Grodsky, James A. Carton, Sumant Nigam, Yuko M. Okamura, **Tropical Atlantic Biases in CCSM4**. *Journal of Climate*, early online release.
[Abstract](#) [PDF \(1250 KB\)](#)

Gerald A. Meehl, Warren M. Washington, Julie M. Arblaster, Aixue Hu, Haiyan Tang, Claudia Tebaldi, Ben Sanderson, Jean-Francois Lamarque, Andrew Conley, Warren G. Strand, James B. White III, **Climate system response to external forcings and climate change projections in CCSM4**. *Journal of Climate*, early online release.
[Abstract](#) [PDF \(9038 KB\)](#)

C. M. Bitz, K. M. Shell, P. R. Gent, D. Bailey, G. Danabasoglu, K. C. Armour, M. M. Holland, J. T. Kiehl, **Climate Sensitivity of the Community Climate System Model Version 4**. *Journal of Climate*, early online release.
[Abstract](#) [PDF \(2920 KB\)](#)

Keith Oleson, **Contrasts between urban and rural climate in CCSM4 CMIP5 climate change scenarios**. *Journal of Climate*, early online release.
[Abstract](#) [PDF \(4052 KB\)](#)

Alexandra Jahn, Kara Sterling, Marika M. Holland, Jennifer E. Kay, James A. Mullanik, Cecilia M. Bitz, David A. Bailey, Julianne Stroeve, Elizabeth C. Hunke, William H. Lipscomb, David A. Polak, **Late 20th century simulation of Arctic sea ice and ocean properties in the CCSM4**. *Journal of Climate*, early online release.
[Abstract](#) [PDF](#)

<http://journals.ametsoc.org/page/CCSM4/CESM1>

CESM Project Science Highlights



New Validation Tools - COSP-Enabled Comparisons

- CAM4 and CAM5 have similar cloud radiative forcing
- However, CAM5 have a much more realistic representation of cloud properties
- As shown here, total cloud fraction is higher and compares better to CALIPSO and ISCCP observations in CAM5

COSP-enabled total cloud comparisons, Kay et al. (in press)

Where we are heading

- Capability for Higher Spatial Resolutions
- New Earth System Component Capabilities
- Improved Model Processes

New Capabilities - Development of an Isotope-Enabled CESM

Simulating Stable Water Isotopes in the Climate System

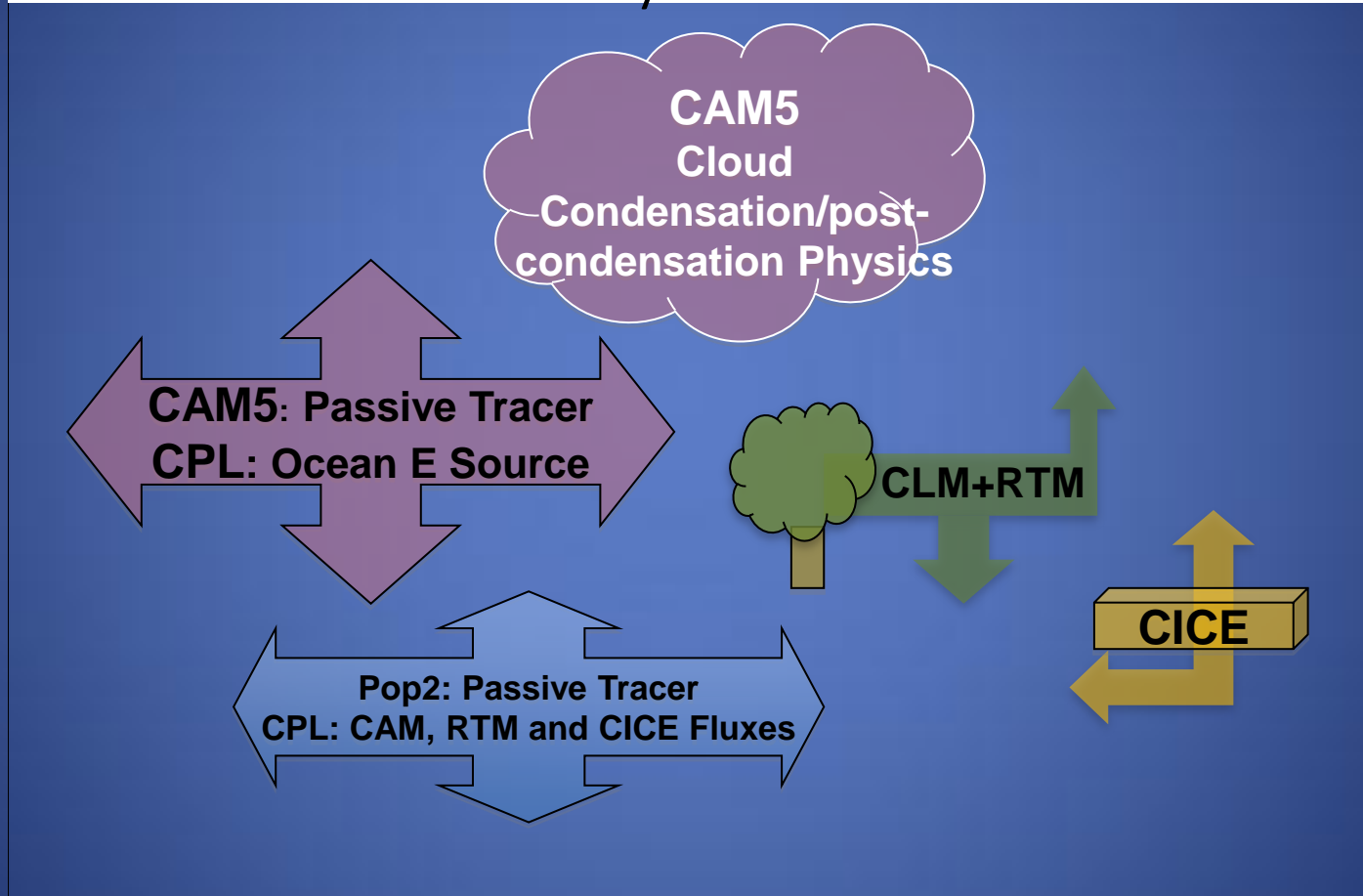
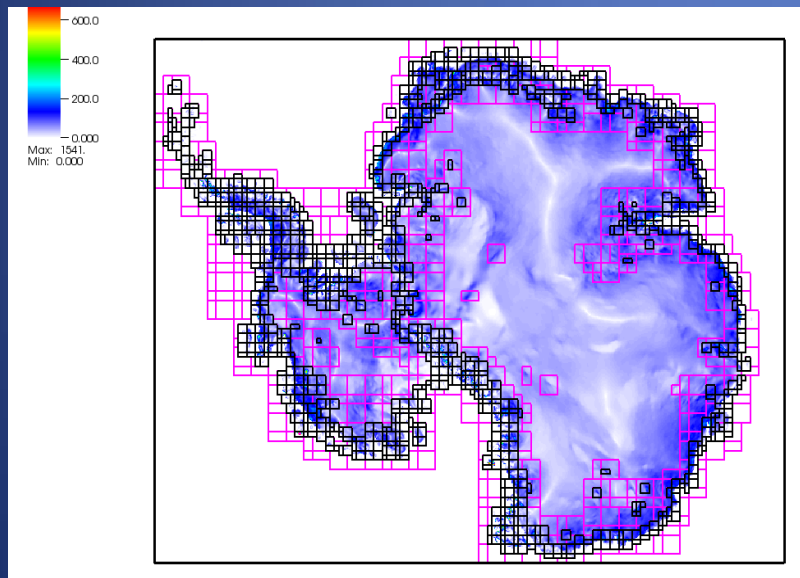


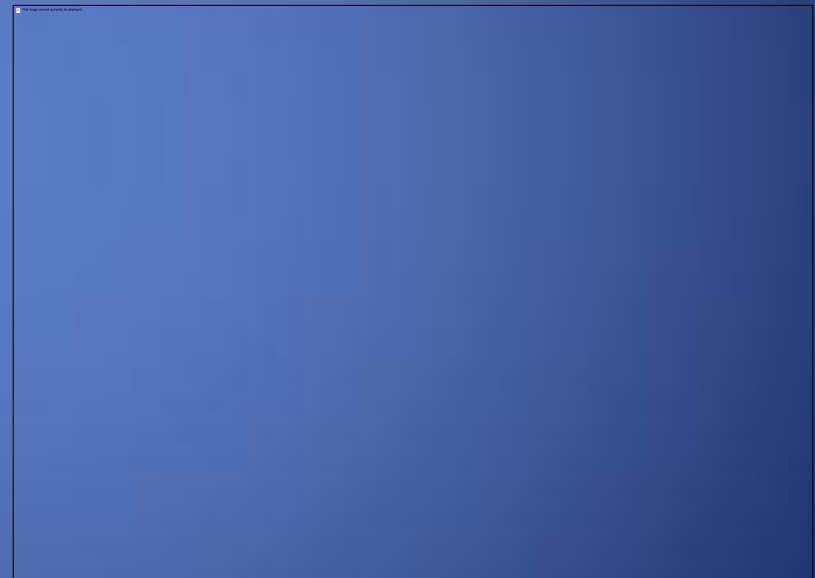
Figure adapted from Paul, A. et al. 1999: Simulation of Water Isotopes in a Global Ocean Model, in *Use of Proxies in Paleoclimatology: Examples from the So. Atlantic*, Fischer G. and W. Wefer, eds., Springer-Verlag, 655-686.

Improved Earth System Processes - New ice sheet dynamical cores

- The Berkeley ISICLES project (BISICLES) has developed a parallel, higher-order dycore based on Chombo adaptive-mesh-refinement (AMR) software.
 - AMR allows high resolution (~1 km) near ice streams and grounding lines.
 - Has been used to study the acceleration of Pine Island Glacier in West Antarctica (Cornford et al., 2011)
- Another group is developing a higher-order, finite-element dycore on a variable-resolution, unstructured mesh (using the MPAS framework).



Antarctic ice speed with higher-order solver on a fully adaptive mesh. (Courtesy of D. Martin)



Sample variable-resolution mesh for Greenland ice sheet

(Slide courtesy of Bill Lipscomb)

New Developments Enable New Science

For Example:

- Assess the importance of new feedbacks and interactions
- Examine regional variability/change
- Assess predictability on interannual-decadal timescales
- Apply new tools to studies of climate variability and change

Questions?



Extra Slides



Increasing Model Capabilities

A subset of developments underway/being considered:

- Coupling to (Data Assimilation Research Testbed) DART, multi-instance capability
- Super-parameterization
- Ocean wave model (WaveWatch)
- Refined and regional grids
- Water and Carbon Isotopes
- New atmosphere dynamical cores
- New Land Ice dynamical cores
- And More...